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**GB 2263668 A EP 0701930 A1 US 5454595 A**

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(54) Air bag arrangement

(57) An air bag arrangement for protecting the occupants of a vehicle from a side impact comprises an air bag, means 2 for inflating that air bag and means for locating the air bag arrangement within a vehicle, the air bag comprising a portion 6 to be disposed adjacent an occupant's torso upon inflation and an upper portion 8 to be disposed adjacent an occupant's head upon inflation, said upper portion comprising at least one part folded inwardly and accommodated within a lower part of the air bag, such that said folded part remains inside the lower part during inflation until the remainder of the air bag has been inflated. The upper portion may additionally comprise two sections (12, 13 figure 4) that are folded within a central area of the upper portion so as to remain there during inflation until the remainder of the air bag has inflated. The inflating means may be a gas generator and the air bag may be mounted within the back 3 of a vehicle seat.

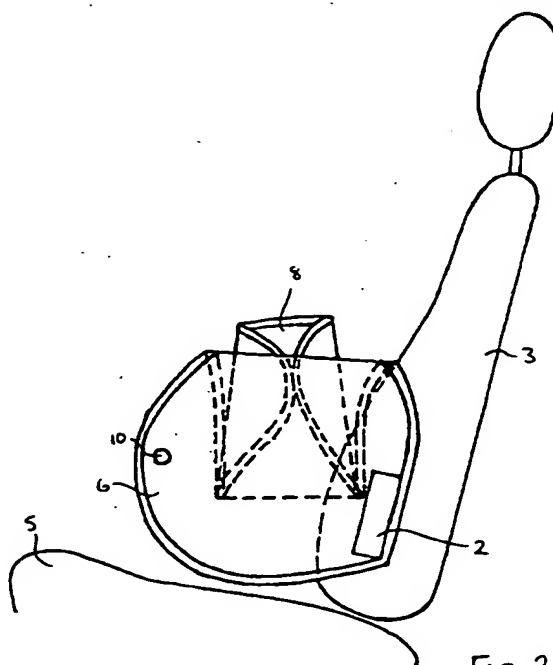


FIG 2

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"IMPROVEMENTS IN OR RELATING TO AN AIR BAG ARRANGEMENT"

THE PRESENT INVENTION relates to an air bag. Air bags are widely used as safety devices in motor vehicles, such as motor cars, to protect the driver or a passenger in the motor vehicle in the event of an accident. Air bags are located in the vehicle at positions such that, when inflated in an accident situation, they are disposed between an occupant of the vehicle and a fixed part of the vehicle such as the steering wheel, the windscreen or the side of the vehicle.

Air bags are typically made of a woven fabric and are inflated by a gas generator, the gas generator being activated by a sensor which is adapted to sense excessive vehicle deceleration or acceleration or which is adapted to sense an impact of the vehicle.

It is known to provide an air bag at the side of the back of a vehicle seat so that when it is inflated in an accident situation it is located between the side of the vehicle and the occupant of the seat. Such an air bag is intended to afford protection during a side-impact accident. Ideally a side-impact air bag of this type will extend from the squab of the vehicle seat upwardly to the level of the head of the occupant of the seat, when inflated, thereby affording protection for the entire upper body and head of the occupant.

In most vehicles, however, there is only limited space between the side of the vehicle and the occupant. In particular, there is only very limited space between the side of the vehicle and the arm/shoulder region of the occupant, whilst there is a slightly greater amount of

space between the head of the occupant and the side of the vehicle and between the occupant's torso, below shoulder level, and the side of the vehicle. These space constraints provide certain problems insofar as the inflation of a single, side-impact air bag is concerned in that the bag must inflate in such a manner as to fill the larger spaces between the head and the torso (below shoulder level) of the occupant and the side of the vehicle and also fill the somewhat narrower space between the occupant's shoulder and the side of the vehicle.

The air bag should therefore have a relatively large head portion and main torso portion interconnected by a somewhat narrower arm/shoulder portion. The present invention addresses the problem of inflating the air bag in a controlled manner such that all three portions of the air bag may be inflated as quickly as possible but without the relatively large head portion of the air bag being inflated before it has moved upwardly through the relatively narrow space between the side of the vehicle and an occupant's arm/shoulder. If the head portion of the air bag is inflated too soon this may result in the air bag being "pushed" behind the shoulder of the occupant where it would not afford the desired degree of protection. Whilst it would be possible to provide two separate air bags, one for the torso and shoulder region and another for the head region, this would give rise to significant additional expense, in particular the additional expense of a second gas generator for inflating the second air bag.

The present invention seeks to provide an arrangement comprising a single air bag which may be inflated in a controlled manner so as to extend up from a position adjacent the squab of the seat of a vehicle to

head level of an occupant of the seat and which does not suffer from the problems outlined above.

This invention provides an air bag arrangement for use in providing protection against a side impact in a motor vehicle, the air bag arrangement comprising an air bag, means for inflating the air bag such that it is disposed between an occupant in the vehicle and the side of the vehicle when inflated and means for mounting the air bag arrangement within the motor vehicle, the air bag comprising a torso portion adapted to be disposed adjacent the torso of an occupant in the vehicle when inflated and an upper portion having an area adapted to be disposed adjacent the head of the occupant in the vehicle when inflated, the upper portion of the air bag comprising at least one region which is folded inwardly so as to be accommodated at least partially inside a lower portion of the air bag, the arrangement being such that during inflation of the air bag the or each folded in region of the upper portion remains folded until the lower portion has inflated.

Preferably the upper portion of the air bag is additionally provided with two sections which are folded inside a central area of the upper portion, the arrangement being such that both of the folded in sections remain inside the central area of the upper portion until the remainder of the air bag has been inflated and only then inflate and extend out of the central area of the upper portion.

Conveniently the upper portion of the air bag comprises a head portion adapted to be disposed adjacent the head of an occupant in the vehicle when inflated and a central, shoulder portion which connects the head portion

to the torso portion, the shoulder portion being adapted to be disposed adjacent the shoulder of an occupant of the vehicle when inflated, the shoulder portion being narrower than the head portion and the torso portion in the direction extending between the side of the vehicle and the occupant.

Advantageously the air bag is formed from opposed layers of material which are interconnected around their periphery, the central, shoulder portion of the air bag incorporating a region over which the layers of material forming the air bag are interconnected thereby resulting in the shoulder portion being relatively narrow in the said region.

The interconnected region may be defined by means of the layers of material from which the air bag is formed being woven together. Alternatively the interconnected region may be defined by means of a seam, which may be a tear seam.

As a further alternative the interconnected region may be formed by means of straps disposed internally in the air bag and extending between the layers of material forming the air bag.

Preferably the air bag is retained in a folded up condition adjacent a gas generator when not in use, the air bag being folded by initially rolling the head portion and subsequently the shoulder portion downwardly to form a rolled up portion of the air bag, the rolled up portion of the air bag then being folded so that it is received inside the torso portion and finally folding or rolling the torso portion (and the head portion and shoulder portion which are accommodated therein) towards the gas generator.

The folding of the air bag may comprise a preliminary step of folding the or each said section of the upper portion inside said central area of the upper portion.

Preferably the rolled up portion of the air bag is folded inside the torso portion such that the rolled up portion extends in a direction generally transverse to the direction in which the torso portion (and the head portion and shoulder portion which are accommodated therein) are folded or rolled towards the gas generator.

Conveniently the air bag arrangement is mounted adjacent one side of the back of a vehicle seat and, during inflation in an accident situation, the torso portion is initially inflated, following which the head portion and shoulder portion move upwardly and forwardly with respect to the seat before the head portion is fully inflated.

In order that the present invention may be more readily understood and so further details thereof may be appreciated, the invention will now be described by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a schematic side elevation of an air bag arrangement in accordance with the present invention when in an inflated condition;

FIGURE 2 is a view showing the arrangement of Figure 1 when in a partly folded up condition;

FIGURE 3 is a view corresponding to Figure 1 but showing a modified arrangement;

FIGURES 4, 5 and 6 are views corresponding to Figure 3 showing the way in which the air bag is folded up from a flat condition, in order to be accommodated within a housing ready for use;

FIGURE 7 is a cross-sectional view taken on the line VII-VII of Figure 4; and

FIGURE 8 is a cross-sectional view taken on the line VII-VII of Figure 6.

With reference to Figure 1 of the drawings an air bag 1 is formed from two layers of fabric which are joined around their edges. The bag is provided with a gas generator 2 which is accommodated within the back 3 of a vehicle seat 4 at a position adjacent the side of the seat which is closest to the side of the vehicle and adjacent the squab 5 of the seat. Sensor means are, of course, provided to activate the gas generator 2 in the event of an accident situation so that the air bag 1 is inflated. In use the air bag 1 is designed to inflate and to be located between the side of the vehicle and the vehicle occupant sitting on the seat 4.

The air bag 1 is shaped so as to define a main torso portion 6 at its base adjacent the squab 5 of the seat 4, a central shoulder portion 7 and a head portion 8 at its uppermost end. When inflated the main torso portion 6 is designed to be disposed adjacent the torso of the vehicle occupant (below shoulder level) whilst the central shoulder portion 7 is designed to be positioned adjacent the shoulder of the occupant and the head portion 8 is designed to be disposed adjacent the head of the vehicle occupant.

The bag 1 can be formed from two layers of woven fabric which are joined around their periphery in a manner which is well known in the art so as to define the enclosure constituting the bag 1. By way of example, International Publication WO90/09295 discloses in detail a technique for weaving together selected areas of two layers of fabric which are formed simultaneously on a loom as a web in order to define an enclosure or bag. The bag could, alternatively, be formed from one layer of material which is folded and sewn to form the bag.

An opening 9 is formed towards the bottom and the rear of the bag 1, the opening 9 serving to accommodate the gas generator 2. The gas generator may in fact be disposed either within the air bag 1 or externally of the air bag 1. Also the bag 1 is provided with one or more vent holes 10, the vent hole ensuring that the bag operates in a satisfactory manner when it is inflated in an accident situation and retains a cushioning effect.

The central shoulder portion 7 of the bag 1 is formed with a seam 11 which extends upwardly in the general longitudinal direction of the air bag at a position approximately midway between the front and rear of the air bag. The seam 11 interconnects the two layers of fabric forming the air bag 1 and holds them together so that the air bag is of a reduced width in this central shoulder portion 7 in keeping with the reduced space which is available between the side of the vehicle and the arm/shoulder of an occupant to be protected by the air bag. The seam 11 may be a tear seam which only holds the two layers of fabric forming the bag together until a predetermined pressure is reached within the bag. Instead of a seam 11 the two layers of fabric from which the air bag is formed may be woven together in the region

identified by reference numeral 11. In either event the bag is so formed as to have a reduced overall width in that central region. As an alternative to the seam 11 short straps may be provided between the layers of fabric to give a reduced width. The straps will extend between the layers of fabric but will not join them together. The straps are oriented such that they will permit a free flow of gas during inflation of the air bag.

It will be appreciated from Figure 1 of the drawings that in an accident situation the bag is inflated from its base via the gas generator 2. During production the woven bag is therefore folded, when in a flat condition, from its uppermost end so as to be disposed adjacent the gas generator 2 within a retaining housing.

In order to provide an arrangement whereby, during inflation of the air bag, the uppermost, head portion of the air bag does not inflate until the lower portion has been inflated, the head portion is folded in on itself so as to be disposed within a lower portion of the air bag. Thus, the uppermost portion of the air bag is folded inwardly to be accommodated within a lower region of the air bag. As will be more clearly appreciated from the following description of a modified arrangement, this serves to provide a design in which, during inflation, initially the lower region of the air bag is inflated before the uppermost region can inflate because a certain pressure must be reached within the air bag before that uppermost region "pops out" and is inflated.

Figure 2 illustrates the air bag when an upper portion has been folded downwardly into the lower or torso portion 6. It will be seen that in this arrangement the front and rearmost regions of the head portion 8 have been

folded over before the upper portion (comprising the head portion) and the central, shoulder portion 7 have been folded inwardly so as to be disposed inside the lower or torso portion 6.

Figure 3 illustrates a slightly modified embodiment in which the head portion of the air bag 1 has enlarged, forwardly and rearwardly projecting regions which may be regarded as "ears" 12, 13. In all other respects the air bag is very much the same as that illustrated in Figure 1 and therefore the same reference numerals have been retained in the drawings relating to the Figure 3 embodiment.

Figures 4, 5 and 6 illustrate the manner in which the air bag 1 of Figure 3 is folded when in the flattened condition, the manner of folding being of particular importance in that it dictates the manner in which the bag will subsequently inflate during an accident situation. The method of folding the air bag 1 will now be described.

As can be seen from Figures 4 and 7 the ears 12, 13 are initially folded inwardly so that they are received within the central area of the head portion 8. The head portion 8 and then the central, shoulder portions 7 are then rolled downwardly until the position shown in Figure 5 is reached. The rolled up portion of the air bag comprising the head portion 8 and the central, shoulder portion 7, is then folded downwardly into the lower, torso portion 6 of the air bag 1 about a fold line 14 in order to reach the position illustrated in Figure 6. It is to be observed that the rolled up portion of the air bag (identified by reference numeral 15 in Figure 6) is folded downwardly into the interior of the torso portion 6 so that it is disposed at an angle of approximately 45 degrees.

This is to facilitate the packing of the air bag adjacent the gas generator 2. Thus, the rolled up portion of the air bag 15 extends across the height of the gas generator so that it does not have to be folded over upon itself as the bag is moved to the fully packaged condition as described below.

The folded up air bag, as shown in Figure 6 is then further folded in a direction towards the back of the seat 4 in order that it may be accommodated within a housing disposed in the back 3 of the seat 4 adjacent the side thereof which is closest to the side of the vehicle. This final stage of folding may consist of effecting a plurality of folds in alternate directions (Z-folding) with the fold lines extending substantially vertically. Alternatively the torso portion including the rolled portion 15 of the air bag may be rolled towards the right so as to bring it to a position immediately adjacent the gas generator 2. Of course any other convenient method may be used to package the air bag in a compact manner adjacent the gas generator 2.

During use, when the sensor means located in the vehicle detect a side-impact accident situation the gas generator 2 is activated and the air bag 1 is inflated in the reverse sequence to that in which it is folded up. Thus, initially the lower, torso portion 6 of the air bag will be inflated to reach the position illustrated in Figure 6. Continued inflation of the bag resolves in the initial unfolding of the folded down portion of the bag so that it reaches the condition shown in Figure 5. During this unfolding procedure the head portion 8 and the central, shoulder portion 7 remain in the rolled up condition. The rolled up portion 15 of the bag will then progressively unroll in an upwards direction, with the

uppermost part of the portion which is unrolling always being in the rolled up condition until the air bag is fully inflated. Thus, the upper most, unrolling part of the air bag is always relatively thin. This ensures that the air bag can inflate passed the shoulder of the occupant of the seat without difficulty before the head portion 8 inflates.

It is to be observed that during these stages of inflation the ears 12, 13 on the head portion 8 of the air bag remain folded inside the central area of the head portion 8 so that the head portion remains of relatively small dimensions as the air bag rises and the relatively narrow, central shoulder portion 7 can move into position adjacent the shoulder of the occupant of the seat 4 without hinderance. It is only once the air bag has reached the fully raised position shown in Figure 4 where the relatively narrow, central shoulder portion is fully inflated that the ears 12, 13 are inflated and "pop out" from the central area of the head portion 8 to give the air bag its final, fully inflated shape as illustrated in Figure 3.

Thus, the relatively large, head portion 8 of the air bag is only fully inflated once the air bag has been raised passed the level of the shoulder of the occupant of the seat 4 whereupon the head portion may fully inflate so as to occupy the space between the head of the person positioned on the seat 4 and the side of the vehicle in order to afford optimum protection for that person's head in the event of a side impact.

It will be appreciated that various modifications may be made to the specific embodiment described above. Thus, for example, the precise shape of the air bag may be varied. Indeed it is to be observed that the drawings are

not to scale and the relative sizes of the different portions of the air bag may, of course, vary as long as the folding arrangement of the air bag is such that, during inflation, the relatively large head portion 8 at the upper end of the air bag is not fully opened until such time as the somewhat narrower, central shoulder portion 7 of the air bag has been fully raised up to or passed the shoulder level of the occupant of the seat 4. If desired the ears 12, 13 of the head portion 8 of the air bag may be held in place inside the central area of the head portion by means of tear seams which only tear and release the ears once the remainder of the air bag is fully (or near fully) inflated.

## CLAIMS:

1. An air bag arrangement for use in providing protection against a side impact in a motor vehicle, the air bag arrangement comprising an air bag, means for inflating the air bag such that it is disposed between an occupant in the vehicle and the side of the vehicle when inflated and means for mounting the air bag arrangement within the motor vehicle, the air bag comprising a torso portion adapted to be disposed adjacent the torso of an occupant in the vehicle when inflated and an upper portion having an area adapted to be disposed adjacent the head of the occupant in the vehicle when inflated, the upper portion of the air bag comprising at least one region which is folded inwardly so as to be accommodated at least partially inside a lower portion of the air bag, the arrangement being such that during inflation of the air bag the or each folded in region of the upper portion remains folded until the lower portion has inflated.

2. An air bag arrangement according to Claim 1 wherein the upper portion of the air bag is additionally provided with two sections which are folded inside a central area of the upper portion, the arrangement being such that both of the folded in sections remain inside the central area of the upper portion until the remainder of the air bag has been inflated and only then inflate and extend out of the central area of the upper portion.

3. An air bag arrangement according to Claim 1 or Claim 2 wherein the upper portion of the air bag comprises a head portion adapted to be disposed adjacent the head of an occupant in the vehicle when inflated and a central, shoulder portion which connects the head portion to the torso portion, the shoulder portion being adapted to be

disposed adjacent the shoulder of an occupant of the vehicle when inflated, the shoulder portion being narrower than the head portion and the torso portion in the direction extending between the side of the vehicle and the occupant.

4. An air bag arrangement according to Claim 3 wherein the air bag is formed from opposed layers of material which are interconnected around their periphery, the central, shoulder portion of the air bag incorporating a region over which the layers of material forming the air bag are interconnected thereby resulting in the shoulder portion being relatively narrow in the said region.

5. An air bag arrangement according to Claim 4 wherein the interconnected region is defined by means of the layers of material from which the air bag is formed being woven together.

6. An air bag arrangement according to Claim 4 wherein the interconnected region is defined by means of a seam.

7. An air bag arrangement according to Claim 6 wherein the seam is a tear seam.

8. An air bag arrangement according to Claim 4, wherein the interconnected region is formed by means of straps disposed internally in the air bag and extending between the layers of material forming the air bag.

9. An air bag arrangement according to any one of Claims 3 to 8 wherein the air bag is retained in a folded up condition adjacent a gas generator when not in use, the air bag being folded by initially rolling the head portion and subsequently the shoulder portion downwardly to form a

rolled up portion of the air bag, the rolled up portion of the air bag then being folded so that it is received inside the torso portion and finally folding or rolling the torso portion (and the head portion and shoulder portion which are accommodated therein) towards the gas generator.

10. An air bag arrangement according to Claim 9, as dependent upon Claim 2, wherein the folding of the air bag comprises a preliminary step of folding the or each said section of the upper portion inside said central area of the upper portion.

11. An air bag arrangement according to Claim 9 or Claim 10 wherein the rolled up portion of the air bag is folded inside the torso portion such that the rolled up portion extends in a direction generally transverse to the direction in which the torso portion (and the head portion and shoulder portion which are accommodated therein) are folded or rolled towards the gas generator.

12. A air bag arrangement according to any one of Claims 3 to 11 wherein the air bag arrangement is mounted adjacent one side of the back of a vehicle seat and, during inflation in an accident situation, the torso portion is initially inflated, following which the head portion and shoulder portion move upwardly with respect to the seat before the head portion is fully inflated.

13. An air bag arrangement substantially as herein described with reference to and as shown in Figures 1 and 2 of the accompanying drawings.

14. An air bag arrangement substantially as herein described with reference to and as shown in Figures 3 to 7 of the accompanying drawings.

15. Any novel feature or combination of features disclosed herein.

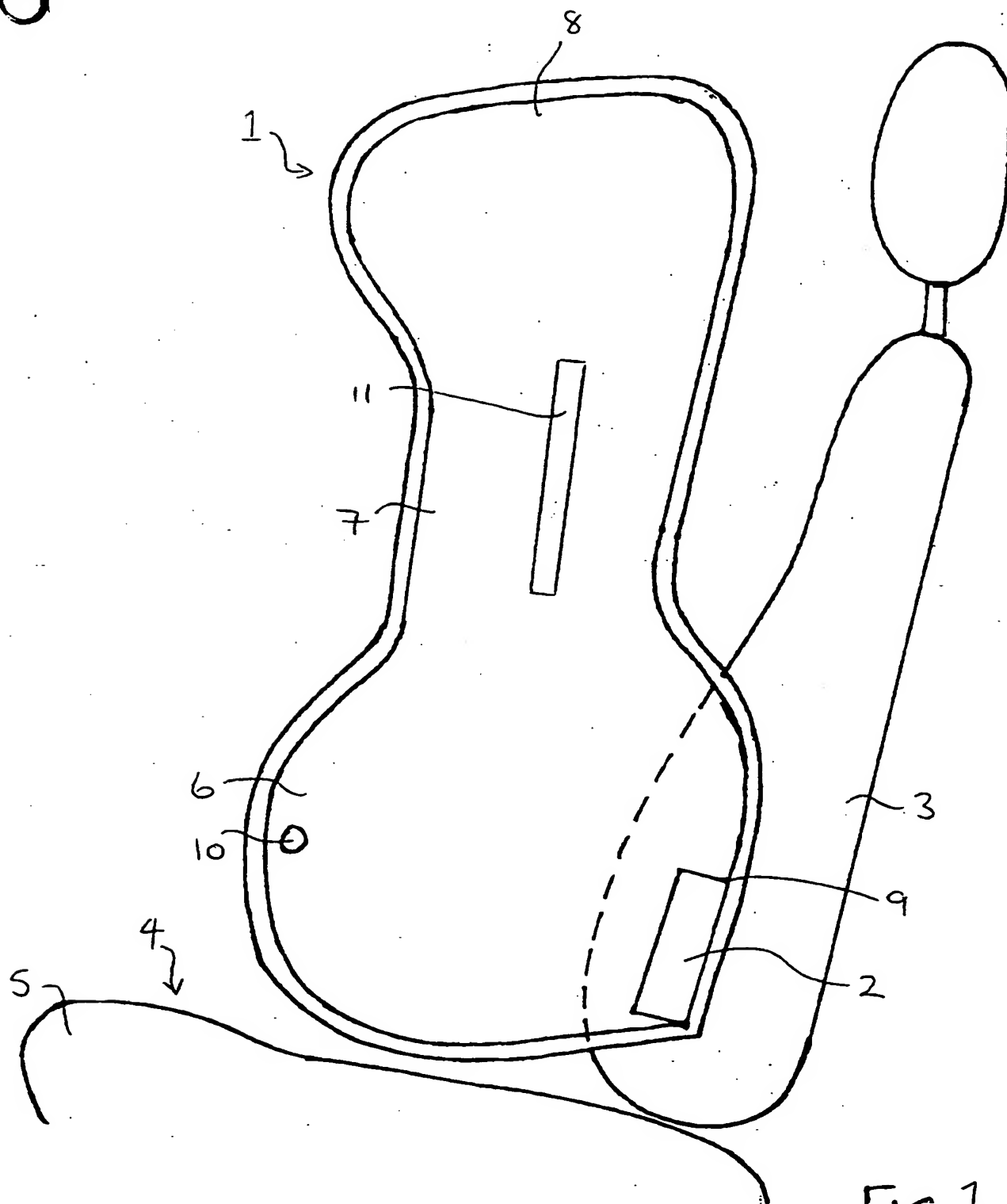


Fig 1

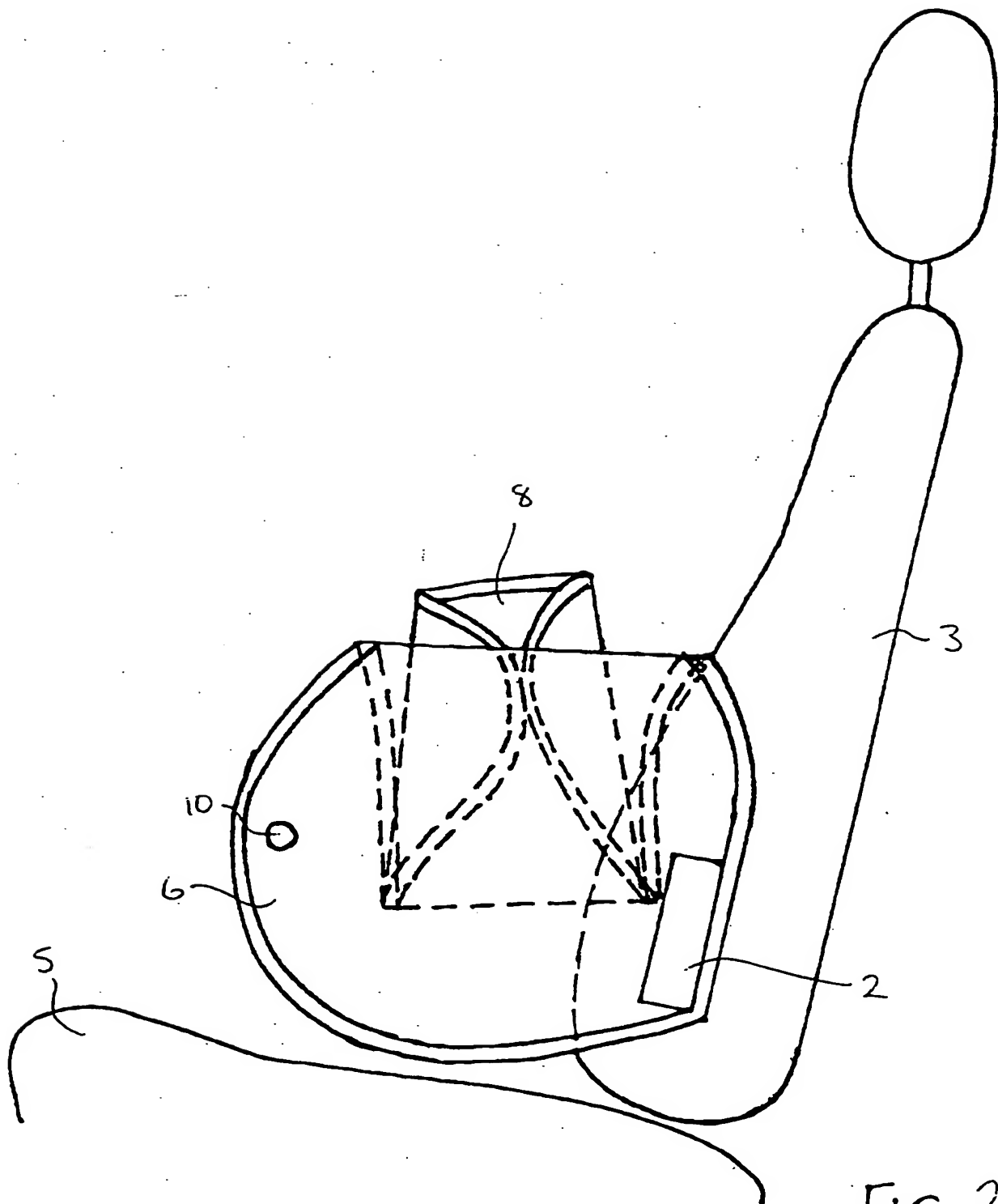
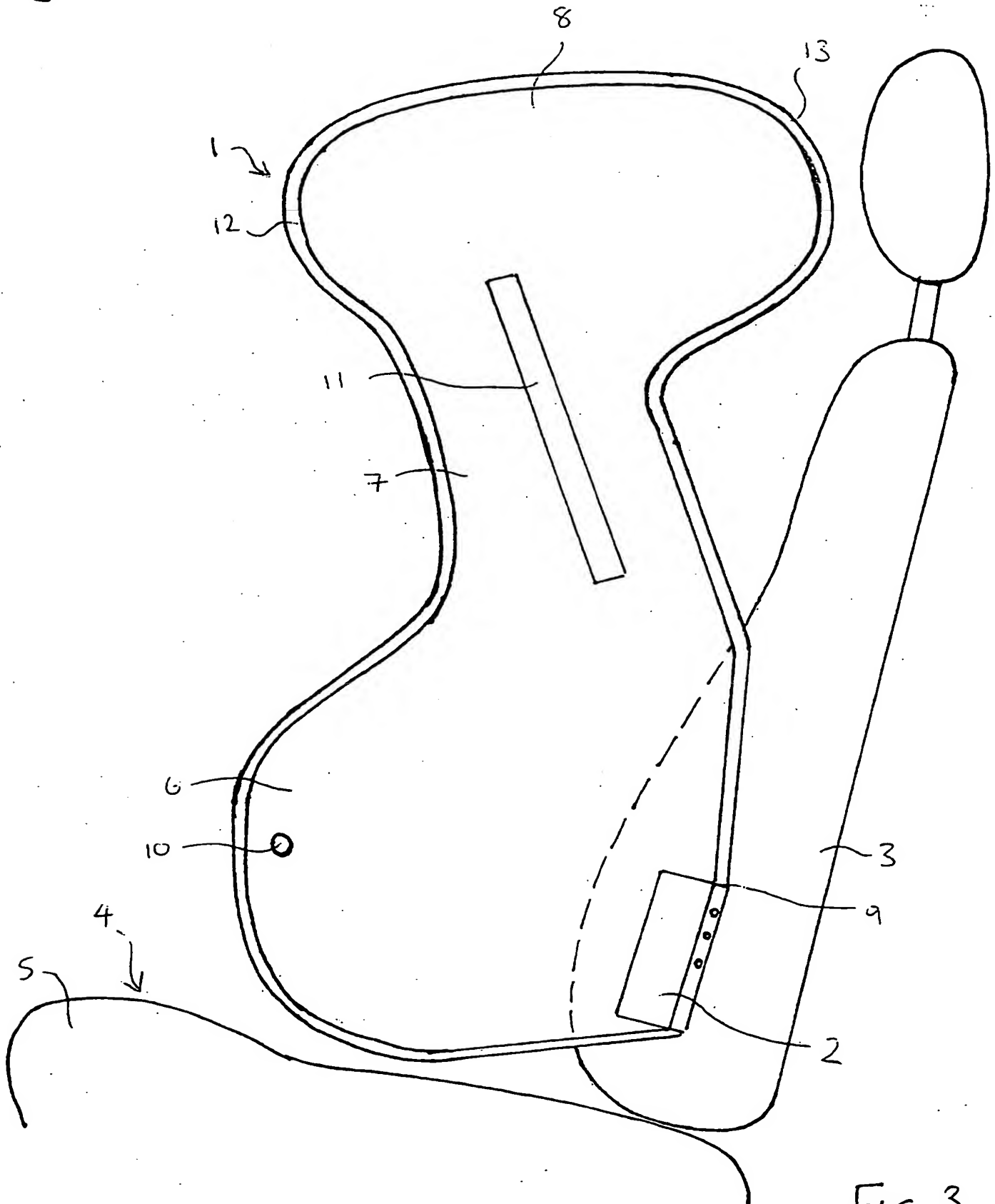
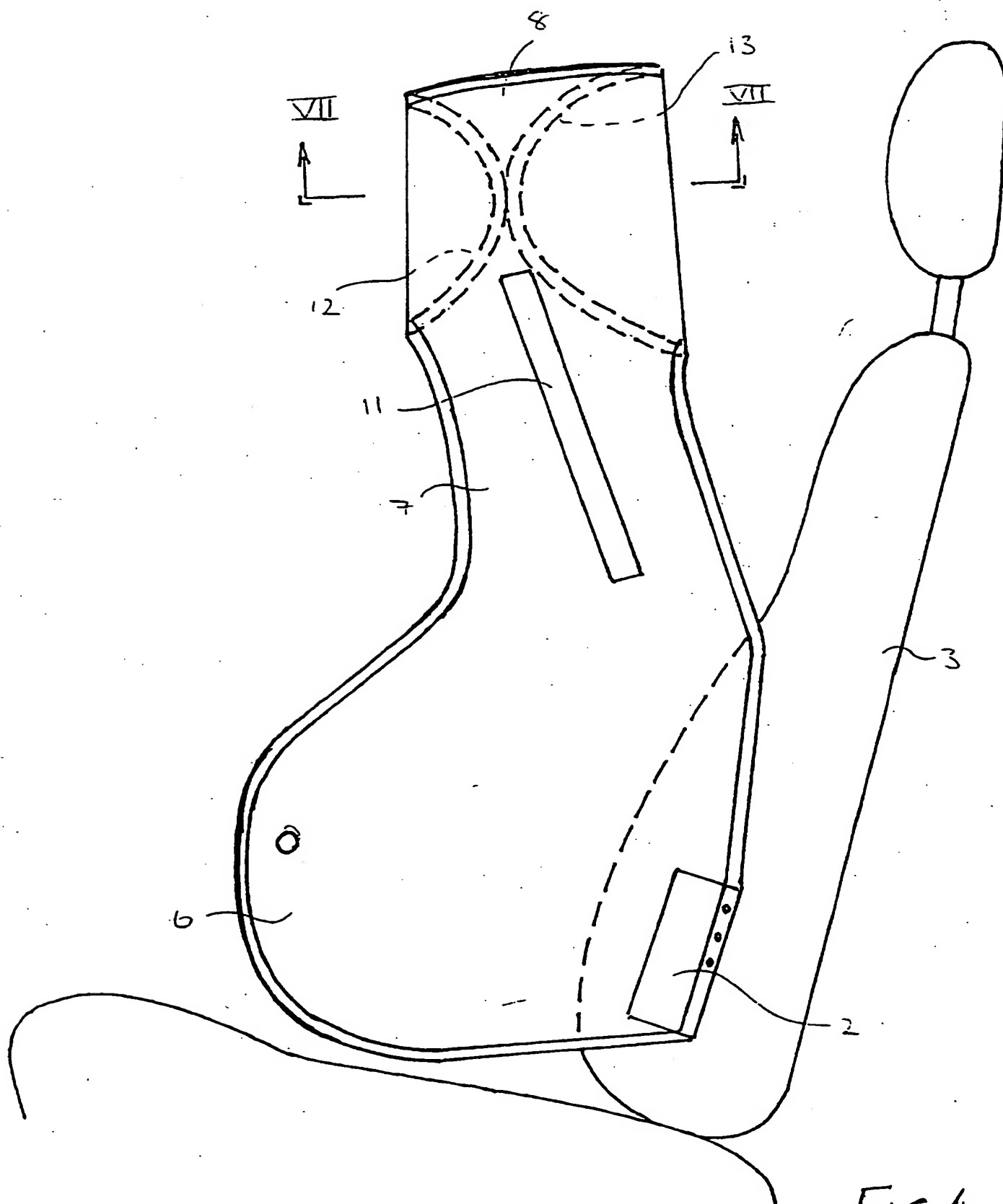
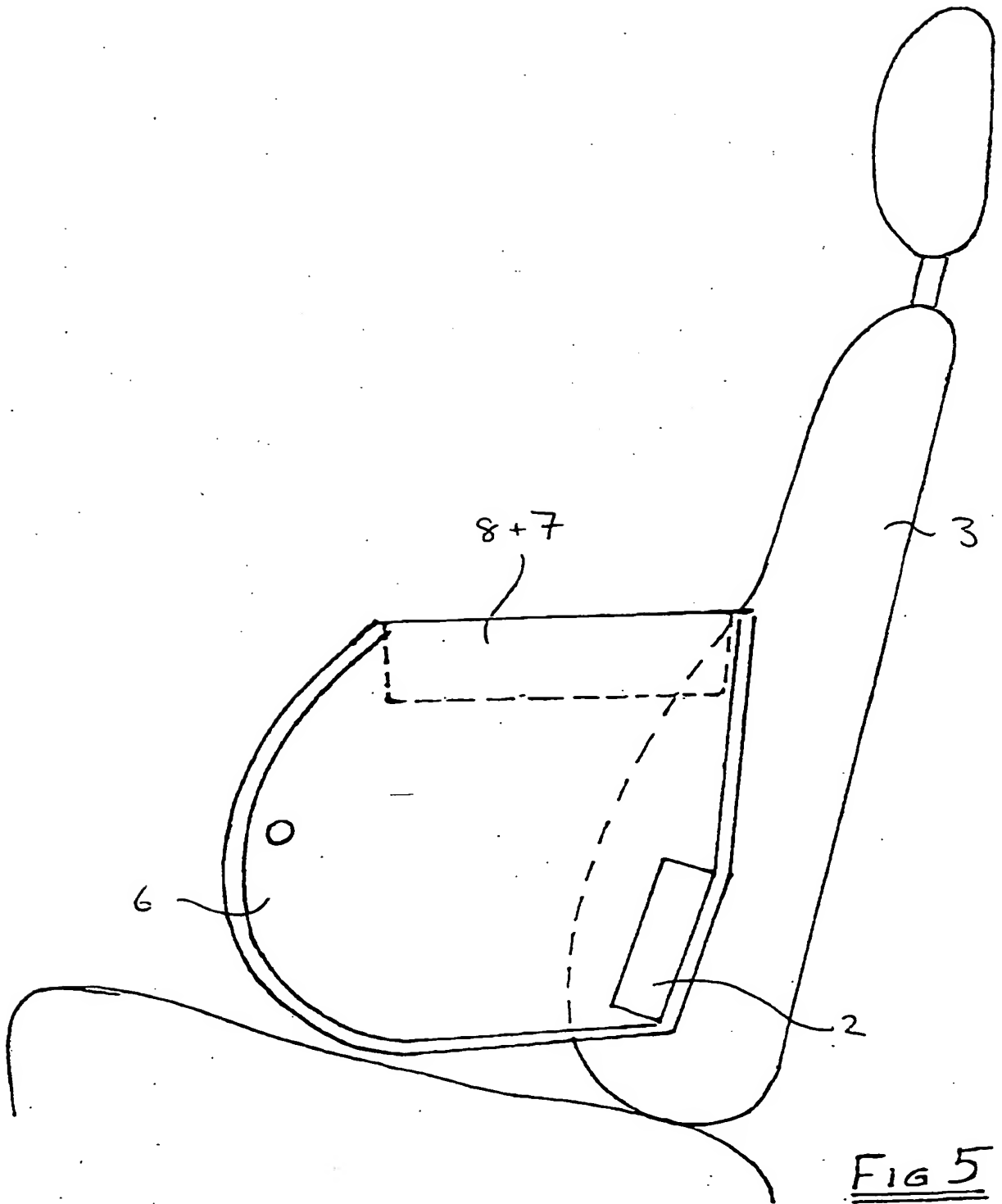


FIG 2

FIG 3

Fig 4



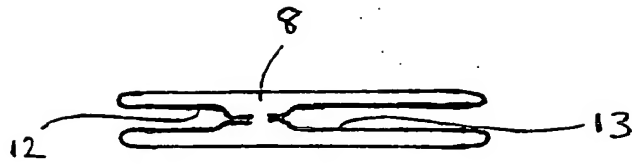


FIG 7

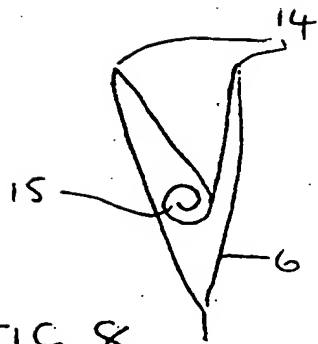


FIG 8

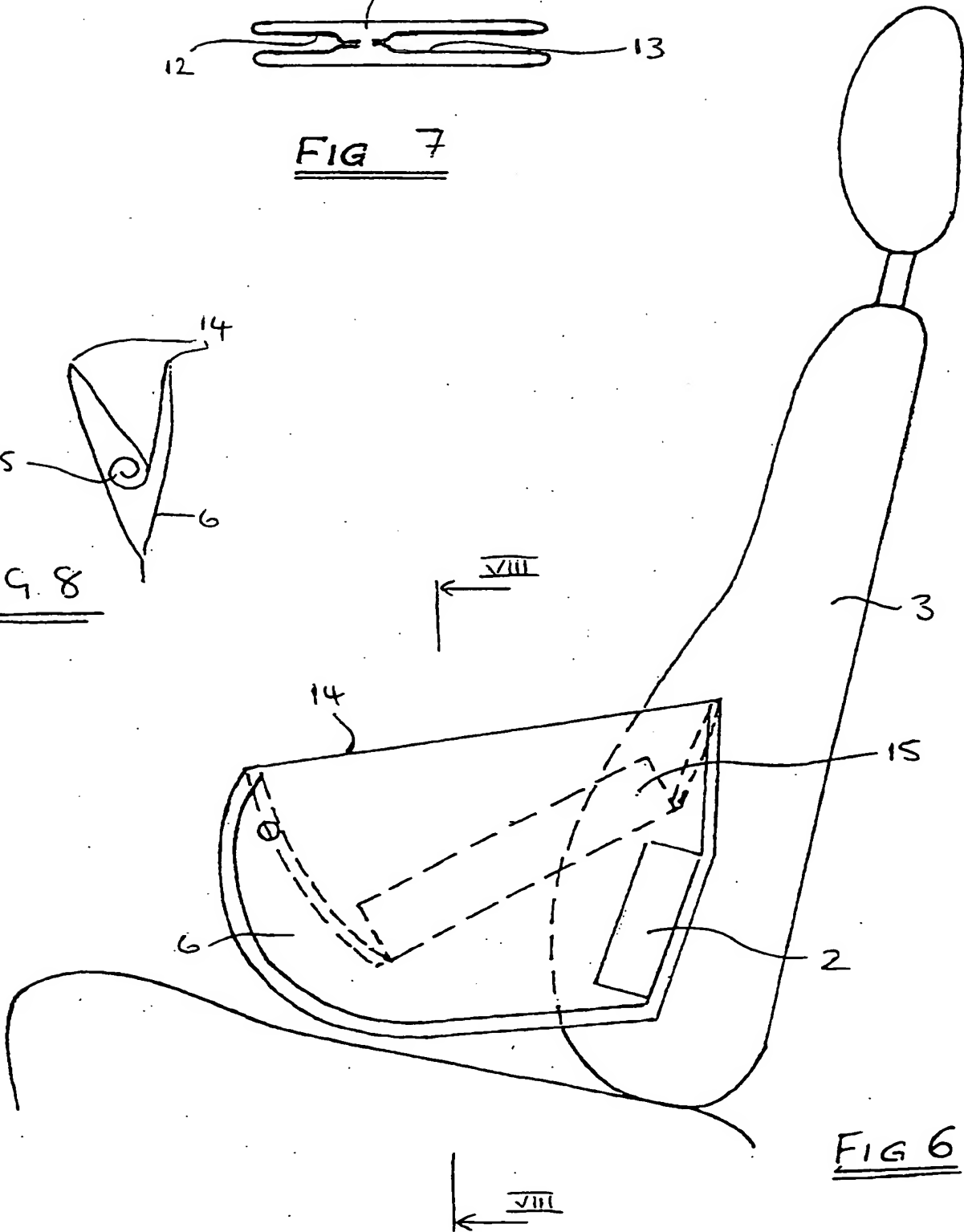


FIG 6



Application No: GB 9621471.3  
Claims searched: 1 to 15

Examiner: Karl Whitfield  
Date of search: 9 December 1996

## Patents Act 1977 Search Report under Section 17

### Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B7B (BSB)

Int Cl (Ed.6): B60R 21/16, 21/20, 21/22

Other: Online database: Derwent World Patents Index accessed via Questel

### Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2263668 A (GENERAL ENGINEERING) see especially figure 5	
A	EP 0701930 A1 (PORSCHE) see especially figure 3 and abstract	
A	US 5454595 (OLSEN et al) see especially figures 1 & 2	

X Document indicating lack of novelty or inventive step  
Y Document indicating lack of inventive step if combined with one or more other documents of same category.  
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A Document indicating technological background and/or state of the art.  
P Document published on or after the declared priority date but before the filing date of this invention.  
E Patent document published on or after, but with priority date earlier than, the filing date of this application.